DURATION OF LIFE WITHOUT FOOD IN DROSOPHILA PSEUDOÖBSCURA

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Race *A* and Race *B* of *Drosophila pseudoöbscura* have been distinguished because they produce sterile male hydrids when crossed. Morphologically the races appear identical, and there are but few physiological characteristics that differentiate them. Thus, Poulson (1934) found that Race *A* flies have a shorter period of development than Race *B* flies. Dobzhansky [1] (1935) has studied the fecundity of both races at different temperatures and showed that during the lifetime Race *A* deposits more eggs than Race *B* at higher temperatures (25° C.), while at lower temperatures (19°, 14°) the relations are reversed. At all temperatures used Race *B* begins to oviposit later than Race *A*. In these experiments Dobzhansky observed also some indications suggesting that the longevity of Race *A* is greater than that of Race *B*. The present study is an attempt to secure further information bearing on this fact. In my experiments the measurements of the duration of life have been made in the absence of food. The data are therefore not necessarily comparable with those of Dobzhansky.

Method

Pearl and Parker (1924) state that any study involving longevity must be so conducted as to eliminate any desiccation; otherwise, the results are due to desiccation and not to the inherent factors which determine the length of life. Furthermore, they state that any technique which permits a fly to obtain water or any liquid even in small drops becomes a food study and not a starvation study. In the present work, however, the interest centered in the reaction of the two races to varying humidities and temperatures and not purely in the length of life at one optimum condition. Undoubtedly at a humidity of 95 per cent the flies took moisture condensing on the side of the tube.

Five bottles each of Texas (A) and Seattle—6 (B) cultures were

[1] The writer wished to express his indebtedness and sincere appreciation to Dr. Dobzhansky.

started on the twenty-ninth of May, each bottle containing 3 females and 5 males from stock that had been under laboratory conditions for some time. These were placed in the 19° (C.) cold room and transferred every 48 hours to fresh bottles, until four successive transfers had been made. Any cultures which showed a total number of pupæ under 100 or above 400 were discarded. On the fourteenth day of the culture's life, the paper was removed from the bottle and the pupæ were scraped from it, using a pair of small forceps. Any pupæ which were coated with food were discarded. The removed pupæ were placed in one-ounce vials, plugged with cotton and placed again at 19° to await the first hatching.

Poulson (1934) found that the maximum hatching occurred between the hours of 6 and 10 A.M., excepting Race *B* females which emerged in greatest numbers between 2 and 6 A.M. Since a fair percentage of the latter also hatch between 6 and 10 A.M. these four

TABLE I

Duration of life (in hours) at densities of 5 and 30 flies per one-ounce vial. Temperature 19° C., humidity 8 per cent.

Race	Five per vial		Thirty per vial		Difference
	$M \pm m$	n	$M \pm m$	n	
Seattle—6 ♀ (B)	71.70±1.18	90	69.60±1.10	60	+2.10±1.61
Seattle—6 ♂ (B)	74.90±2.01	70	68.80±1.44	60	+6.10±2.45
Texas ♀ (A)	102.57±1.20	105	97.05±1.17	150	+5.52±1.67
Texas ♂ (A)	104.88±1.76	75	98.67±1.33	90	+6.21±2.19

hours were chosen as the most convenient within which one might obtain representative populations. Each day of the hatch, therefore, all vials were emptied of imagines at 6 A.M., and at 10 A.M. the flies which had emerged were etherized and placed in sterilized glass vials, 20 per vial, sexes segregated. Each vial was covered with a piece of medium muslin, held tight by a rubber band. The flies were allowed to recover from the effects of etherization before being placed in desiccators. Using Obermiller's (1924) table of vapor pressures over salt solutions, the following chemicals were used: concentrated H_2SO_4 for 0 per cent, KOH (fused) for 8 per cent, $K_2CO_3 \cdot 2H_2O$ for 43 per cent, and K_2SO_4 for 95 per cent humidity.

After recovery the vials were numbered and placed upright in the desiccator, using a piece of white cardboard to hold the single row of vials close to the glass of the desiccator so that counts could be taken without removing the desiccator top.

Results

An attempt was made to determine the length of life of *D. pseudoöbscura* at two population densities. Pearl and Parker (1924) found that, on food, densities from 35 to 45 flies per bottle were optimum for *D. melanogaster*. At lower and especially at higher densities a reduction of the life span was observed. The data for *D. pseudoöbscura* are presented in Table I.

Table II

Duration of life at two temperatures and four different humidities

		Humidity 0 Per cent		Humidity 8 Per cent		Humidity 43 Per cent		Humidity 95 Per cent	
	Race	$M \pm m$	N	$M \pm m$	N	$M \pm m$	N	$M \pm m$	N
Temperature, 19°	Seattle—6 ♀	70.38 ± 1.91	60	77.64 ± 1.62	120	94.28 ± 1.01	238	101.60 ± 1.90	51
	Sequoia—8 ♀	63.10 ± .755	60	65.12 ± 1.77	161	81.00 ± 1.28	180	104.25 ± 1.39	48
	Texas ♀	85.76 ± 1.10	60	97.20 ± .77	55	102.97 ± .69	396	127.60 ± .98	53
	Mara—3 ♀	67.45 ± 1.14	129	85.80 ± 1.93	130	100.68 ± 1.47	139	110.52 ± 2.02	60
	Seattle—6 ♂	74.0 ± 1.39	60	74.40 ± 1.14	131	99.10 ± 2.415	210	92.40 ± .13	70
	Sequoia—8 ♂	66.75 ± .955	60	66.37 ± 1.15	159	89.22 ± 1.20	160	102.00 ± .86	40
	Texas ♂	74.46 ± 1.87	60	91.32 ± 1.06	100	104.93 ± .80	254	111.0 ± 1.33	40
	Mara—3 ♂	73.57 ± 1.02	110	87.00 ± 1.88	97	99.84 ± 2.10	120	113.10 ± 1.90	40
Temperature, 24°	Seattle—6 ♀			53.52 ± .90	120	55.16 ± 1.80	100	60.50 ± 1.10	40
	Sequoia—8 ♀	35.46 ± .45	100	45.60 ± .733	80	57.08 ± 1.37	80	65.10 ± .705	100
	Texas ♀	57.30 ± .945	80	63.50 ± 1.06	100	73.84 ± 1.45	60	85.80 ± 1.67	40
	Mara—3 ♀	35.58 ± .498	100	50.88 ± .657	220	63.60 ± 1.63	80	74.40 ± 2.36	80
	Seattle—6 ♂			50.79 ± .98	120	54.68 ± .566	120	62.76 ± .115	40
	Sequoia—8 ♂	37.80 ± .54	60	43.84 ± .857	80	56.05 ± 1.25	60	71.66 ± .945	80
	Texas ♂	59.52 ± 1.36	60	62.57 ± .917	100	75.46 ± 1.43	80	87.90 ± 1.43	80
	Mara—3 ♂	38.40 ± .39	80	52.80 ± .622	200	71.55 ± 1.36	60	76.83 ± 1.65	60

The data presented in Table I tend to show that the lower density is more favorable for *D. pseudoöbscura* than the higher one. They show furthermore that the duration of life of Race *A* is greater than that of Race *B*. The latter conclusion must, however, be checked in several respects. First of all, the fact that one strain of Race *A* differs from one strain of Race *B* does not necessarily indicate that the difference is characteristically racial; it may be a property of the particular strains used. Moreover, a difference observed under one set of conditions may be obliterated or even reversed under other conditions. The longevity of the flies has therefore been studied at temperatures 19° and 24° C., and at humidities of 0 per cent, 8 per cent, 43 per cent and 95 per cent (Table II). Finally, a variety of strains of both races coming from different parts of their distribution area has been studied (Table III).

Among the strains used, Texas, Mara, Julian, Oaxaca, Olympic, Pavilion, and Taos belong to Race *A*, and Seattle, Sequoia, Campbell, Crater, Quilcene, and Quesnel to Race *B*. It can be seen from Tables

II and III that in general Race *A* tends to be more long-lived than Race *B*. Nevertheless, some intra-racial variation is observed. Thus, the longevity of the Texas strain is greater than that of the Mara strain; the Quesnel strain is superior to other Race *B* and to some Race *A* strains. It may be noted that at 95 per cent and 43 per cent humidity Race *A* strains are in general superior in longevity to Race *B*. At lower humidities, especially at 0 per cent, a greater degree of overlapping between races is observed. Qualitatively, the

TABLE III

Duration of life in nine strains of *D. pseudoöbscura* at 24° C. and three different humidities

	Humidity 0 Per cent			Humidity 43 Per cent		Humidity 95 Per cent	
	Race	$M \pm m$	N	$M \pm m$	N	$M \pm m$	N
Race *B*	Campbell—4 ♀	40.13± .770	90	48.85±.615	80	68.57±1.40	80
	Crater—2 ♀	38.09± .628	60	46.80±.514	60	61.86±1.05	60
	Quilcene—4 ♀	40.00± .740	90	47.04±.648	60	66.24±1.68	40
	Quesnell—5 ♀	46.91± .655	60	56.12±.727	68	69.43±1.585	60
	Campbell—4 ♀	41.02± .634	103	51.64±.605	80	66.62±1.54	60
	Crater—2 ♂	38.10± .715	60	50.00±.595	60	62.15±1.095	82
	Quilcene—4 ♂	38.84± .500	120	43.08±.468	60	57.30±1.49	60
	Quesnell—5 ♂	47.07± .475	60	55.41±.495	80	59.10±1.295	60
Race *A*	Julian E—6 ♀	53.02± .770	80	63.72±.755	60	83.62±1.96	60
	Oaxaca—4 ♀	43.08± .707	85	50.64±.741	60	90.54±1.86	80
	Olympic—2 ♀	46.62± .684	80	61.58±.787	40	92.05±1.69	80
	Pavillion—5 ♀	49.25± .705	89	66.37±.455	100	88.88±1.54	60
	Taos—1 ♀	49.89±1.18	70	56.40±.800	60	70.10±1.54	80
	Julian E—6 ♂	47.02± .655	100	60.00±.482	80	76.44±2.21	60
	Oaxaca—4 ♂	45.32± .644	100	56.57±.616	60	90.73±2.41	60
	Olympic—2 ♂	46.85± .632	90	65.43±.880	40	92.93±1.68	80
	Pavillion—5 ♂	50.00± .806	60	64.87±.545	80	89.73±2.01	40
	Taos—1 ♂	51.78± .955	60	61.60±.641	80	64.56±2.00	60

effects of humidity and temperature are identical for all strains studied. The duration of life is greater at the lower temperature (19°) than at the higher one (24°), and at higher humidities than at the lower ones.

The two races of *D. pseudoöbscura* differ in their geographical distribution. Race *B* is restricted to the northern part of the Pacific Coast, while Race *A* lives much further eastward and southward than Race *B* (Dobzhansky, 1935, 1937). As far as our data show, the effects of humidity and temperature on the duration of life in the absence of food have little bearing on the geographical distribution of

the two races. Further studies, especially those on the duration of life in the presence of food, may conceivably throw more light on this problem.

Summary

1. In the absence of food, the duration of life of *Drosophila pseudoobscura* is greater at lower temperatures, greater humidities, and lower population densities studied.

2. With temperature, humidity, and population density being kept constant, Race *A* lives longer than Race *B*. These differences between the races is more pronounced at higher than at lower humidities.

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